Type of programme: full-time master 3-semesters with no of hours /week and ECTS

Field of education: Geodesy and Cartography, specialization Geodesy and Satellite Navigation

No	Course	Sem. I				Sem. II				Sem. III			
l - lecture, e - exercices, p - project, E - exam		l	e	p	ECTS	l	e	p	ECTS	l	e	p	ECTS
General courses													
1	Selected issues of economy law	1			1								
2	Human rights					1		2					
3	Geodetic and Cartographic Law									1	1		2
4	Specialist foreign language										2		1
5	Mathematics		2		3								
6	Selected Topics of Mathematics and Numerical Methods /F	1	2		4								
7	Geophysics	1	1		2								
8	Selected Topics of Physical Geodesy and Geodynamics			1	2								
9	Digital image processing			2	2								
Profiled courses													
10	Reference Frames in Geodesy			1	2								
11	Space Geodetic Techniques /E	1		2	3								
12	Surveying studies for legal purposes	2		2	4								
13	Engineering Surveying /E	1		1	3								
14	Geodetic Service of the Construction Process	1		1	2								
15	Standards in Geographic Information	1			2								
16	Facultative class 1					2			1				
17	Facultative class 2					1	1		2				
18	Facultative class 3					2			1				
19	Facultative class 4					2			1				
Specialization courses													
20	Advanced Methods of GNSS Data Processing /E					1		2	4			2	2
21	Physical Geodesy /E					2		2	5			1	1
22	Geodetic Metrology							1	1				
23	Selected Topics of Navigation /E					2		2	5			1	1
24	GNSS Augmentation Systems					1		2	4			1	1
25	Algorithms of Geodetic Data Analysis					1		2	5				
26	Field measurement - geodynamic network										2		1
27	Diploma Seminar										2		1
28	Diploma Thesis												20
	TOTAL	9	5	10	30	15	0	12	31	1	7	5	30

Courses descriptions

General courses	
Selected issues of economy law 1060-GK000-MSP-1001 Wybrane działy prawa gospodarczego	1. Basic information on economic law 2. Sources of law, including the economic law 3. Legal entities. an individual and a legal person, methods of their creation and their legal capacity. 4. The principles of representation of legal persons. 5. Basics principles of obligation. Contracts as a source of obligations. The principle of freedom of contracts. Modes of concluding a contract, in particular in the economy. 6. The principles of fulfillment of contractual obligations. Consequences of non-performance or improper performance of the contract. 7. Taking up and running a business. The concept of the entrepreneur. Forms of runnning and requirements for starting a business. 8. Economic freedom and its limitation 9. Registration of running of an individual entrepreneur in the Central Register of Economic Activity, Polish Classification of Economic Activity 10. Company law. Principles of establishing companies. Register of Entrepreneurs of the National
Geodetic and Cartographic Law 1060-GK000-MSP-3004 Prawo geodezyjne i kartograficzne	Lecture: Tasks of the organs of the geodetic and cartographic service. State geodetic and cartographic repository - management, sharing, fees, licenses. Submission of geodetic and cartographic works. Coordination of utilities network projects. Protection of geodetic controls. Geodetic works in closed areas. Technical standards applicable in surveying. Rules for completing technical reports. Professional qualifications in the field of geodesy and cartography. Exercises: Preparation of a geodetic work application. Preparation of a fee calculation document for materials for the submitted geodetic work, drawing up a license for the above-mentioned geodetic and cartographic materials. Preparation of a technical report for the submitted work and the content of the technical report for a specific assortment of surveying work. Preparation of an application for authentication of geodetic materials resulting from surveying work. Preparation of a notice of completed surveying work. Preparation of an application for coordination of the utilities network project
Specialist foreign language 1060-GK000-MZP-3990 Język obcy specjalistyczny	Achieving the B2+ level of knowledge of a foreign language by expanding the specialist vocabulary related to geodesy and cartography and improving other skills that will enable students to communicate freely in a foreign language, prepare effective presentations and write an abstract of a master's thesis, report or texts in a foreign language useful in their professional work.
Mathematics 1060-GK000-MSP-1003 Matematyka	Functions of complex variable: function derivative, Cauchy-Riemann equations, holomorfic function. Integration of complex function, Cauchy integral theorem, Cauchy integral formula, Laurent series, residual of the complex function and its application for the computation of integrals. Basic equations of mathematical physics. Partial differential equations of the first and second order and their classification. Differential equations of the string and of the thermal conductivity. Fourier method of the separation of variables. Integration and ultra-tight (deep) integration.

Selected Topics of Mathematics and Numerical Methods **/E** 1060-GK000-MSP-1016 Wybrane zagadnienia matematyki i algorytmiki	The main purpose of the course is to give students theoretical and practical knowledge on the selected methods of random signals analysis. The course will present mathematical background and describe algorithms of empirical data analysis, both in the time and frequency domain. The course will begin with a short introduction to the theory of probability, random variables and their parameters. Next, given is description of the random signals with special attention paid to the properties of stationarity and ergodicity. The basic characteristics of the signals are introduced: mean value and variance, probability density, autocorrelation and power spectral density (PSD) functions, then the joint characteristics: joint probability density, cross correlation and the cross power spectral density (CPSD). The data analysis algorithms will include the classical methods, based on the digital Fourier transform, and the parametric methods focusing on the autoregressive (AR) modeling of time series. The last part of the course is devoted to the application of the linear Kalman filter to the time domain analysis of discrete data. It begins with definition of the linear dynamical system using the state-space formulation, then the filtering equations are derived. The project part of the course includes application of the computer programs for analysis of empirical data.
Geophysics 1060-GK000-MSP-1017 Geofizyka	The purpose of this course is to give the students a basic knowledge on the folowing subjects: The Earth as a planet. Internal structure of the Earth. Isostasy - postglacial rebound. Plate tectonics: oceanic rifts, subduction zones, orogens, transform boundary. Rheology. Seismology: seismic waves, seismic wave propagation, Richter scale. Earth's magnetic field: parameters, units, constituents, geodynamo hypothesis. Magnetic surveying: magnetic anomalies. Geomagnetic poles, equator and coordinates (calculation of). Paleomagnetism, polarity reversals. Magnetosphere, magnetic storms and solar activity. Hydrological cycle, physical properties (density, optical, acoustic) of oceanic water. Physical oceanography: thermocline, waves, currents, deep-water circulation, oceanic tides. Basic of fluid dynamics. Particular attention is paid to the interactions between geophysics and geodesy. That includes those geophysical theories and models which are used in geodetic practice, as well as the geodetic observations and models which can support geophysical research.
Selected Topics of Physical Geodesy and Geodynamics 1060-GK000-MSP-1018 Wybrane działy geodezji fizycznej i geodynamiki	Gravimetric measurements - construction of a gravimeter, preparation for measurement (calibration, adjustment) - calculation exercise: determination of the gravimetric factor from measurements on a calibration basis. Gravimetric measurements - Development of a gravimetric measurement with the calculation of the tidal correction - calculation exercise: preparation of the results of a gravimetric span measurements with relative method. Gravimetric measurements - development of measurement results: calculation of the field correction, calculation of reductions and gravimetric anomalies - calculation exercise: preparation of a map of free air anomalies and the
	Tidal deformations - determination of the deformation of the earth's crust caused by tidal phenomena, static and dynamic tidal model - computational exercise: determination of the deformation of the earth's crust in the neu system for a specific point in a given period. Non-tidal deformations - determination of deformations caused by non-tidal phenomena (atmosphere, hydrology or anthropogenic and local factors) - computational exercise: determination of the Earth's crust deformation in the neu system for a specific point. Implementation of the EVRF2007 system - determination of the increments of geopotential number with the use of real gravimetric measurements and geopotential models - accuracy analysis - computational exercise: determining the increments of geopotential features for a selected leveling line, reduction to zero tide. The phenomenon of isostasy and its importance for the implementation of the geodetic network - computational exercise: modeling of the isostatic effect on the basis of the GNSS time series (Fennoscandia). Gravity field of simple geometric solids - elements of geophysical interpretation - computational exercise: modeling of gravity field anomalies resulting from anomalies of subsurface formations. Elements of the gravity field in connecting the natural (related to the plumb line) and geodetic (related to the normal line) coordinate system - computational exercise: reduction of traverse elements from the tacheometric
Digital image processing 1060-GK000-MSP-1005 Cyfrowe przetwarzanie obrazów	1. Registration and development of a digital image 2. Digital image recording formats. 3. Lossy and lossless image compression methods. 4. Basics of image processing in Matlab (Computer Vision System Toolbox ™) 5. Basics of image processing in Python 6. Preprocessing (Matlab) and automatic image vectorization (ArcGIS) 7. Detection and analysis of text on images using the function Optical Character Recognition (OCR) 8. Clustering algorithms and the basics of machine learning for digital image classification. 9. Contextual processing: removing noise from an image through selected low-pass filters and detection characteristic elements of the image through high pass filters 10. Basics of mathematical morphology. 11. Basics of image texture analysis: fractal analysis, GLCM, granulometric
Profiled courses	
Reference Frames in Geodesy 1060-GK00G-MSP-1001 Geodezyjne Układy Odniesienia	The content of the exercises: 1. Estimation of a station velocity on the basis of position time series - introducing discontinuities - estimation of seasonal terms - detection of outliers 2. Extrapolation of coordinates to the desired epoch 3. Transformation of coordinates between two terrestrial reference systems 4. Estimation of station velocities using plate tectonics models 5. Estimation of plate rotation pole on the basis of GNSS velocity field. Estimation of intraplate velocities.
Space Geodetic Techniques **/E** 1060-GK00G-MSP-1002 Satelitarne techniki pomiarowe	Geodetic satellites, classification and history. Equations of motions of satellites The role of atmosphere in satellite geodesy GNSS: GPS, GLONASS, Galileo - error sources, classification - atmospheric effects: ionosphere, troposphere. - antenna phase center variations. Multipath. - differences of observation, linear combinations - GNSS data processing in regional networks SLR and DORIS satellite techniques VLBI - space geodetic technique Satelite altimetry and its missions Earth gravity field. CHAMP, GRACE, GOCE missions. Reference frames realized by space geodetic techniques: ITRS/ITRF. Space geodetic techniques services : IGS, EUREF, ILRS, IDS, IVS. GGOS. Applications of space geodetic techniques in

Course	Description
Surveying studies for legal purposes 1060-GK00G-MSP-1005 Geodezyjne opracowania do celów prawnych	Lecture: Surveying procedures and documentation prepared for the purposes of administrative and court proceedings and surveying works related to the determination of the course of boundary lines and location of crossing points. Real estate delimitations – surveying procedures and documentation, criteria of determination of the course of boundaries, and types of resolutions of administrative and court proceedings. Real estate divisions – surveying procedures and documentation – administrative proceedings (act on real estate management and special acts concerning regulation of legal statuses of public roads and railway areas; court proceedings and divisions of agricultural and forest real estate. Land consolidation (surveying procedure and documentation). Land consolidation and division (surveying procedure and documentation). Land usucaption. Land easements. Delineations of real estate covered with surface waters. Renewal of boundary marks and designation of boundary marks (surveying procedures and documentation, rules of use of archival materials and accuracy of determination of coordinates of boundary marks). Determination of the course of boundaries of registered plots (surveying procedure and documentation, criteria of the course of boundary lines). Design practice: preparation of selected documents - maps, directories, and registers, and
Engineering Surveying /E 1060-GK00G-MSP-1003 Geodezja inżynieryjna	Lectures: Geodetic measurements for construction service and operation control of the railways (4 hours), Specialistic techniques of industrial measurements (autocollimation of parallel and convergent light rays, autoreflection (5 hours),Control measurements of rotary kilns (2 hours), Surveying tasks in underground construction and mining (2 hours), Measurement of unstable objects on the example of shipbuilding (1 hour), Measurements of the special objects. Measurements on the closed areas – excluded from local government administration (1 hour). Project exercises: Measurement and development of the reconstruction project on the example of a railway section (5 hours), Development of the tunnel construction measurements service project (4 hours.), Autocollimation measurements: azimuth transfer in
Geodetic Service of the Construction Process 1060-GK00G-MSP-1004 Geodezyjna obsługa budowy	1. The process of preparing a construction investment (maps for design purposes, supplementary measurements, field interview in the field of finding technical equipment for the area. 2. GESUT. 3. Local Development Plan and Decision on development conditions. 4. Plot development plan, preparation for applying for a building permit. 5. Workplaces for realization of various building objects (formal and technical basics). 6. Geodetic elaboration of a construction project. 7. Object location staking. 8. Building and assembly control systems in servicing the construction of an industrial and residential facility. 9. Geodetic measurement techniques used at various stages of construction implementation. 10. Control measurements of assembly elements and structures. 11. As-built acceptance. 12. Regulations and
Standards in Geographic Information 1060-GK00I-MSP-1000 Normy w zakresie informacji geograficznej	Lectures: 1. Concepts of standard and norms. Objectives and tasks of standardization. 2. The subject, structure, and organization of standardization in GI. OGC standards, ISO standards. 3. Standards formalism, ISO / TS 19103 specification - UML language and ISO 19109 - rules of application schemas. 4. Selected issues from the ISO 19100 series standards: - describing the position (ISO 19107, ISO 19125-1, ISO 19111 and ISO 19112); - temporal scheme (ISO 19108); - data quality (ISO 19157 and ISO 19158); - cataloging methodology (ISO 19110); - metadata (ISO 19115); - XML language - GML (ISO 19136 and ISO 19139). 5. Rules for the use of standards in specific applications.
Facultative class 1 - BIM in Construction Site Survey of Building Investments 1060-GK000-MSP-2011 Facultative class 1 - BIM w obsłudze inwestycji	Lectures: BIM Standards and Initiatives; BIM Guides and Execution Planning; Uses of BIM; Levels of BIM; Impact of BIM; The Evolution to Object-Based Parametric Modeling; Parametric Modeling of Buildings; Creating a model based on a point cloud; BIM Environments, Platforms, and Tools Overview of the Major BIM Design Platforms; BIM for Owners and Facility Managers; Scope of Design Services; BIM Use in Design Processes; BIM for Contractors; Processes to Develop a Contractor Building Information Model; Construction Analysis and Planning; Integration with Cost and Schedule Control and Other Management Functions.
Facultative class 1 - Measuring systems in surveying engine	Measuring systems - automation in land surveying, data integration, multisensor approach. Basics of the sensoric. Structural monitoring systems - definition, applications, monitoring vs control measurements, system overview, using different coordinate types, defining limit classes and alarming. Measuring systems in metrology - instrumentation, interoperability, system designing, measurement uncertainty estimation, examples. Principles of robotic instruments - design, working fundamentals, mechanics, modern trends. Fibre optical measuring systems. Standards and procedures how to apply them in measuring systems?
Facultative class 2 - UAV Technologies in Situational and Altitude Surveying 1060-GK000-MSP-2010 Facultative class 2 - Technologie UAV w geodezyjnych pomiarach sytuacyjno-wysokościowych	1. Introduction to the class. Basic information on unmanned aerial vehicles (2h) 2. Legal provisions regarding the use of UAV aviation law (2h) 3. Review of photogrammetric UAV platforms and RGB, NIR, multispectral, hyperspectral, LIDAR sensors (2h) 4. Planning and development of photogrammetirc missions with the use of UAV (2h) 5. Processing of photogrammetric data obtained from the UAV (2h) 6. Regulations in the field of geodesy and cartography regarding the use of data from UAV platforms (2h) 7. Presentations of exemplary geodetic works using UAV data (2h)
Facultative class 2 - Generation and Application of 3D Buildings Model	"1. Introduction to 3D building modelling (1h) 2. Approaches and methods of building modelling (3h) a. Solid models of buildings b. Surface models of buildings c. Parametric approach 3. Standards and examples of 3D building modelling (3h) 4. Assessment and quality control of data in 3D city models (3h) a. Assessment of completeness of models b. Assessment of geometric accuracy c. Approaches in analyzing the accuracy of model evaluation 5. 3D spatial data in advanced three-dimensional analyzes a. acquiring 3D models (transforming 2D data to 3D), downloading data from the resource b. data structure 6. 3D spatial analyzes - tools and applications
Facultative class 3 - Property Valuation Methodology 1060-GK000-MSP-2012 Facultative class 3 - Metodyka wyceny nieruchomości	Introduction to the issues of real estate appraisal. The value of the property as the basis for the appraisal. Approaches, methods, and techniques of real estate appraisal in Poland, including:- types of approaches, methods, and techniques of real estate appraisal, and rules of their application: - comparative approach, covering: pairwise comparison method, method of correction of average price, method of statistical analysis of the market; - income-oriented approach, covering: investment method, profits method, technique of simple capitalisation, technique of discounting streams of income; - cost-oriented approach, covering: replacement cost method, substitution cost method, detailed technique, technique of elements of integrated circuits, index technique; - mixed approach, covering: residual method, method of land

Facultative class 4 - Applications of Aerial and Satellite Photogrammetry 1060-GKFIT-MSP-3006 Facultative class 4 - Zastosowania fotogrametrii lotniczej i satelitarnej	Lectures: 1. Products of aerial and satellite photogrammetry in agriculture 2. The role of aerial and satellite photogrammetry in the LPIS system (application, standards, examples of documentation of photogrammetric works within LPIS) 3. The use of photogrammetric data in crisis management (discussion of selected flood prevention and counteraction programs) 4. The role of photogrammetry in the modernization of building and land register using photogrammetric method. Assessment of the possibility of using UAVs in the building and land register update 5. Project of the IT System for Country Protection against extraordinary threats (scope of photogrammetric works, examples of order documentation, contractor's reports, photogrammetric data control protocols within ISOK) 6. Effective use of photogrammetric data in hydraulic modelling 7. Application of photogrammetric data and products in security and defense 8. The role of aerial and satellite photogrammetry in creating topographic studies. The use of photogrammetry in BDOT10k production. 9. Aerial and satellite photogrammetry in urban and spatial planning. 10. Measurements of engineering structures with the use of aerial photogrammetry. 11. Discussion of the role of photogrammetric data in the implementation of the CAPAP project (examples of specifications, contractor reports and control protocols of 3D building models) 12. Products of aerial and satellite photogrammetry in forestry and environmental protection 13. Products of aerial and satellite photogrammetry in mining and power engineering 14. The use of aerial and satellite photogrammetry in earth sciences 15. Products of aerial and satellite photogrammetry in archaeology 16. The use of aerial photogrammetry techniques in the humanities. "

<div align="center">Specialization courses</div>

Advanced Methods of GNSS Data Processing **/E** 1060-GKGNS-MSP-2000 Zaawansowane metody opracowania obserwacji GNSS 1060-GKGNS-MSP-2000 Zaawansowane metody opracowania obserwacji GNSS	1. Characteristics of GNSS: GPS, GLONASS, Galileo 2. Terrestrial and celestial reference systems and their mutual relation 3. Equations of motions of satellites. Perturbations 4. GNSS observations 5. Advanced modelling of GNSS observations: - error sources, classification - atmospheric effects: ionosphere, troposphere - antenna phase center variations. Multipath - satellite and receiver clock errors - relativistic effects 6. Observational equations, differences, and linear combinations 7. Processing of GNSS observations. Double differences, PPP 8. Applications of GNSS 9. Geodetic services: IERS, IGS, EUREF
Physical Geodesy **/E** 1060-GKGNS-MSP-2009Geodezja fizyczna 1060-GKGNS-MSP-3007Geodezja fizyczna	Lectures: 1. International gravimetric Reference Frame - history and contemporary implementation. 2. Elements of statistics in the study of the field of gravity as a tool for the description and interpolation of the field of gravity. 3. Study of the figure of the Earth with gravimetric methods - Stokes theory, Molodensky theory, Hotine's approach, RCR method as a tool for determining a gravimetric geoid. 4. Influence of topography in modeling the field of gravity. 5. The height determination in the definition related to geopotential features. 6. Determination of geopotential models - mathematical foundations and computational strategy for connecting satellite and terrestrial observations. 7. Application and validation of geopotential models. 8. Time (periodic) geopotential models and their application in tracing environmental and geodynamic processes on Earth. 9. Global Geodetic Earth Observation System with emphasis on gravimetric observation methods.
	Exercises: 1. Determining the difference in the value of the geopotential of the local system in relation to the global model. 2. Determination of the distances of the geoid from the ellipsoid using the gravimetric (classical) anomaly according to the Stokes theory. Determination of the distances of the geoid from the ellipsoid by means of a gravimetric disturbance according to the Hotine's approach. 3. Methods of matching the gravimetric geoid to satellite-leveling data. 4. Determination of the field correction based on the numerical terrain model. Full topographic reduction using the topopotential model. Indirect effect of condensation reductions and reductions of topographic masses eliminating. 5. Preparation and alignment of a fragment of the height network in the classical way (normal heights) and with the use of geopotential numbers. 6. Determination of the GM model of the given resolution on the basis of gravimetric terrestrial data. 7. Validation of global potential models. 8. Determination and interpretation of the EWT parameter on the basis of temporal geopotential models. 1. Establishment of a basic gravimetric / integrated point. 2. Determination of differences in geopotential features on the benchmarks of the leveling line. 3. Determination of the curvature of the real plumb line. 4. Microgravimetric measurement with the interpretation of residual anomalies. 5. Integration of geophysical measurements (gravimetry, seismic, magnetism, GPR) - a point carried out in cooperation
Geodetic Metrology 1060-GKGNS-MSP-2010 Metrologia Geodezyjna	Goals and history of geodetic metrology. Legal metrology. Legal institutional structure in metrology. The structure of patterns and the way of comparison and legalization of geodetic instruments.
Selected Topics of Navigation **/E** 1060-GKGNS-MSP-2011Wybrane Działy Nawigacji□ 1060-GKGNS-MSP-3008Wybrane Działy Nawigacji	1 Introduction to navigation: the basics of historical navigation, maps and navigation maps. 2 Classification of navigation technologies: indoor navigation, outdoor navigation: land, sea, air, deep space navigation 3 Navigation reference systems, positioning methods and measurement techniques: 4 Triatellation (ToF, RSS), triangulation (AoA), navigation hyperbola (TDOA), comparative navigation (terrestrial), proximity. 5 Basic navigation parameters. Kinematic equation of motion and its integration 6 The principle of operation of selected navigational sensors: inertial (accelerometer, gyroscope), magnetic (magnetometer), pressure (barometer) sensors. Error characteristics of selected navigation sensors. 7 Satellite Navigation Systems (current systems). 8 Architecture of GNSS systems: GBAS, SBAS), radio navigation (Loran), inertial navigation (INS, AHRS), 9 Navigation formats and standards: NMEA, RTCM. 10 Navigation augmentation systems: augmented (SBAS, GBAS), aided (pseudolites, LTE, 5G), assisted (AGPS). 11 Mathematical representation of the orientation of mobile platforms: directional cosines, Euler angles, and Quaternions. 12 Orientation of moving objects, estimation methods: complementary filter, Kalman filter, Madgwick, Mahony 13 GNSS based attitude determination - multi-antenna GNSS system. 14 Integrated navigation systems (INS/GNSS): dead - reckoning, loose coupling, tight coupling 15 Monitoring of reliability control of navigation systems (RAIM, ARAIM) 16 Autonomous navigation (based on autonomous car- autonomous driving level, vehicle to vehicle navigation,) 17 Mobile laser scanning 18 Required navigation performance (RNP) performance requirements. Procedures for the

	GNSS Augmentation Systems 1060-GKGNS-MSP-2012Systemy wspomagania GNSS 1060-GKGNS-MSP-3009Systemy wspomagania GNSS	1. Errors in differential GNSS measurements: determination methods (observation residues, linear combinations, differences), temporal and spatial characteristics. 2. DGNSS code-based technology: coordinate domain, observation domain and state-space domain correction models, existing SBAS / GBAS systems (EGNOS, other commercial). 3. RTK / RTN carrier-phase based techniques: mathematical model of positioning, diagram of a network solution, networks / corrections available in Poland. 4. Ambiguity resolution in kinematic GNSS measurements: methods of integer estimation, strategies for AR, validation tests. 5. Kalman filter in kinematic positioning: mathematical model for relative phase positioning. 6. Structure of the atmosphere: basic models, equation of state, tropospheric features, water vapor in the atmosphere. 7. Tropospheric delay: dry and wet refractivity, tropospheric delay models. 8. IWV / IPW water vapor content integral: calculation, IPW climatology. 9. Numerical weather forecasting and tropospheric delay data: construction of equations, popular models. 10. Tropospheric gradients, empirical mapping functions, ray tracing. 11. Structure of the ionosphere: layers, composition, variability, solar activity, solar wind, ionosphere measurements, ionospheric delay modeling. 12. Ionospheric and tropospheric delays in satellite geodesy measurements: tropospheric delay estimation methodology, various types of ZTD solutions, available software, ionospheric mapping functions, databases within IGS and EPN services (tropospheric and ionospheric products)
	Algorithms of Geodetic Data Analysis 1060-GKGNS-MSP-2013 Algorytmy analizy danych geodezyjnych	Interpolation methods. Alternative, direct transform of geodetic coordinates to cartesian coordinates. Spectral analysis, FFT, Lomb-Scargle method, spherical harmonics. Elements of adjustment theory. Time series analysis. Solving numerical problems using programming language of students choice.
	Field measurement - geodynamic network 1060-GKGNS-MSP-3011 Ćwiczenia terenowe - sieci geodynamiczne	The GNSS measurements method of the geodynamic network - calibration of gravimeters on selected spans of the Fundamental National Gravimetric Network - gravimetric measurements using static instruments - precise and trigonometric levelling - determination of geoid undulation in the field - measurements using a laser scanner in the power plants station Czorsztyn-Niedzica
	Diploma Seminar	Principles of writing an Msc thesis, guidelines for the thesis exam, presentations of the scope and progress of the thesis, practicing the ability to present the results of their work